*I*nformation *T*echnology
for Engineering & Manufacturing

The Process Specification Language

The goal of PSL is to create a process interchange language that is common to all manufacturing applications, generic enough to be decoupled from any given application, and robust enough to be able to represent the necessary process information for any given application. This representation would facilitate communication among the various applications because they would all have a common understanding of concepts to be shared. PSL is intended to include a default interchange language that manufacturing applications can use to communicate.

Presented by Michael Gruninger

(Further information unavailable.)

Scroll to start
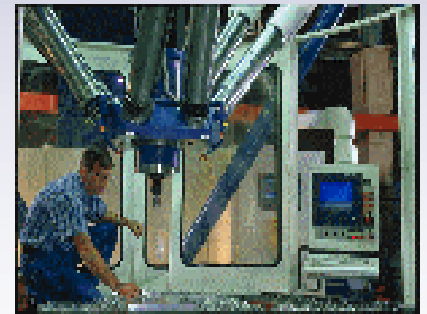
Challenge 1: Interoperability
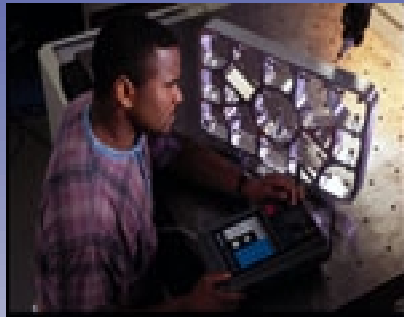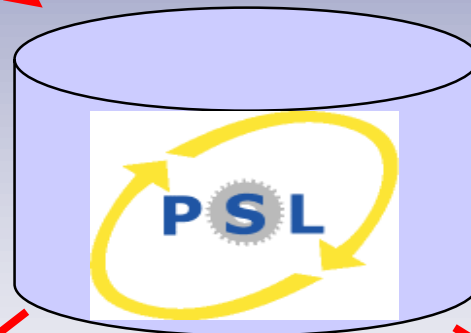

Process Modeler
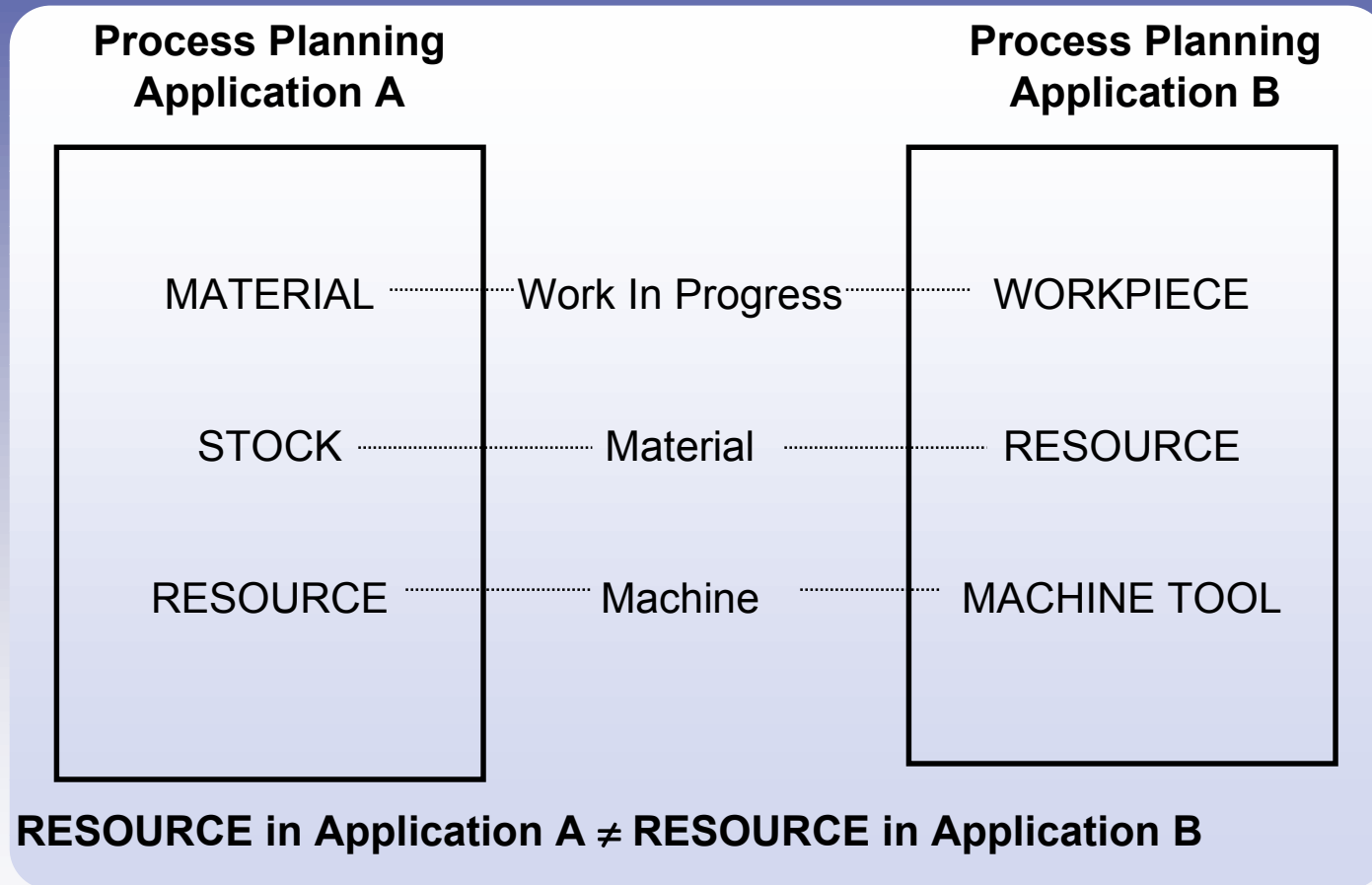
Process Planner

Simulator
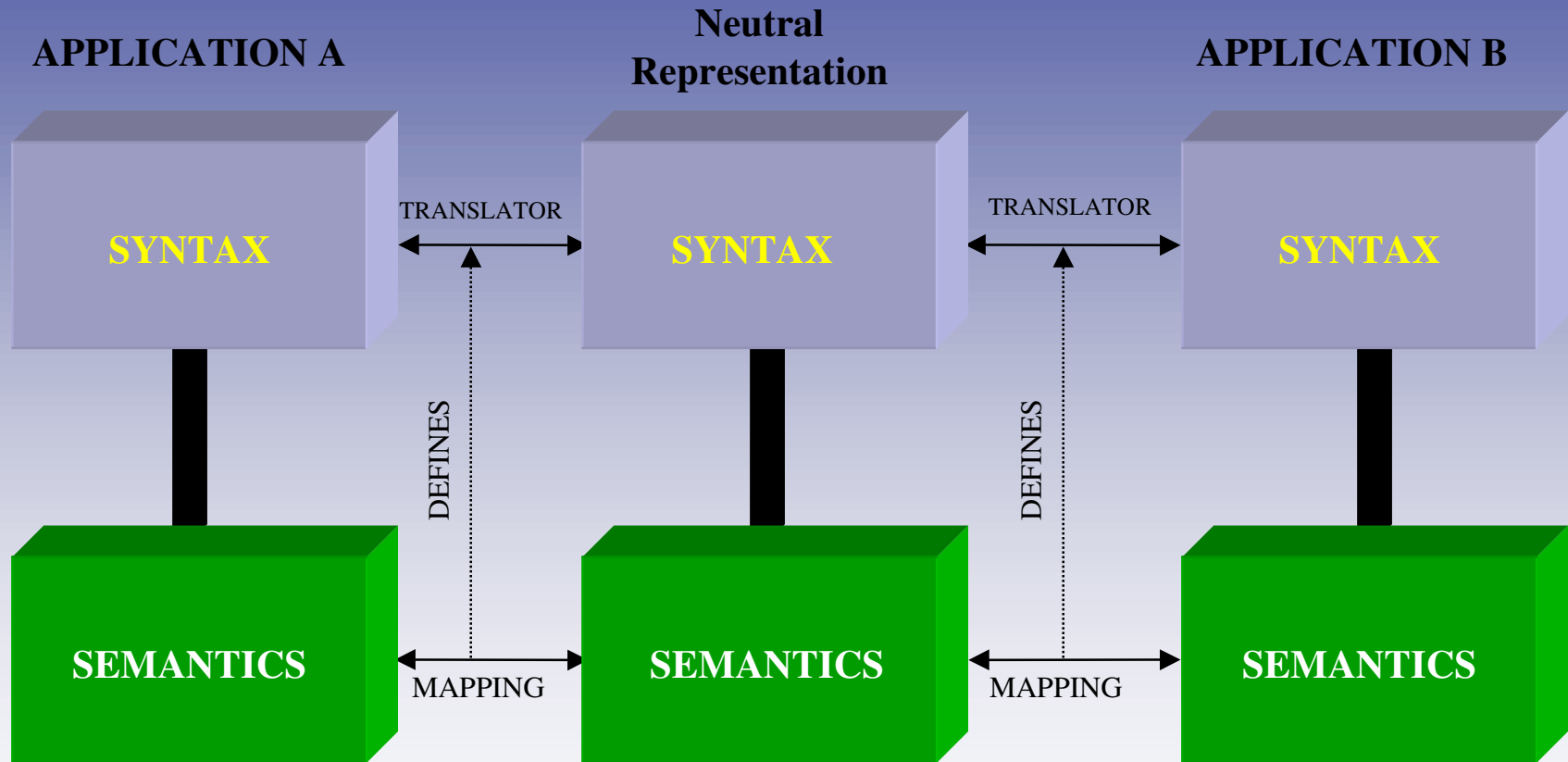
Scheduler

Challenge 2: Virtual Enterprises

- The creation and support of virtual enterprises is hindered by the lack of a common understanding of their business processes.

- A common language for processes enables the integration of the business practices of partners within the virtual enterprise.

Why Semantics?

Process Planning Application A   **Process Planning Application B**

MATERIAL ········· Work In Progress ········· WORKPIECE

STOCK ········· Material ········· RESOURCE

RESOURCE ········· Machine ········· MACHINE TOOL

RESOURCE in Application A ≠ RESOURCE in Application B

Need to unambiguously capture meanings of terms for all current (and future) uses

Exchange Scenario

APPLICATION A   Neutral Representation   APPLICATION B

SYNTAX   TRANSLATOR   SYNTAX   TRANSLATOR   SYNTAX

DEFINES   DEFINES

SEMANTICS   MAPPING   SEMANTICS   MAPPING   SEMANTICS

What is PSL?

- What PSL currently is:
  - a multi-year effort at NIST to develop a neutral representation of manufacturing process information
  - a modular, extensible data model (ontology) capturing concepts inherent to process specification
- What PSL will be:
  - a language to be used as an interlingua to exchange process information among industrial applications

PSL-Core: Concepts

- Entities:
  - `activity, activity-occurrence, timepoint, object`
- Relations:
  - `before, between, beforeEq, betweenEq, is-occurring-at,participates-in, exists-at`
- Functions:
  - `beginof, endof`

Extensions for "Baby" PSL

- New Extensions
- Ordering Relations
- Processor Actions
- Resource Paths
- Resource Roles
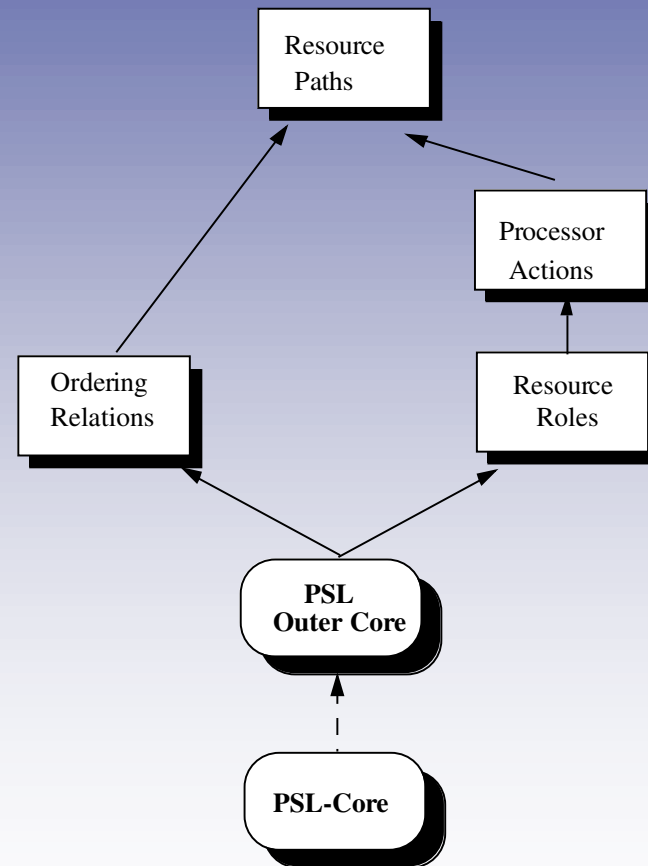
Pilot Implementation

- The pilot implementations have:
  - driven the growth of the PSL ontology through the identification of concepts needed in various manufacturing fields.
  - ensured that PSL was truly addressing the needs of vendors and end users.
 - involved writing translators to/from PSL to ensure its usability.

Pilot Implementations (cont.)

- The first pilot, completed in September 1998, exchanged process information between the ProCAP process modeler and the ILOG Scheduler.

- The second pilot, to be completed in September 2000, will exchange process information between the MetCAPP process planner and the Quest simulation package.

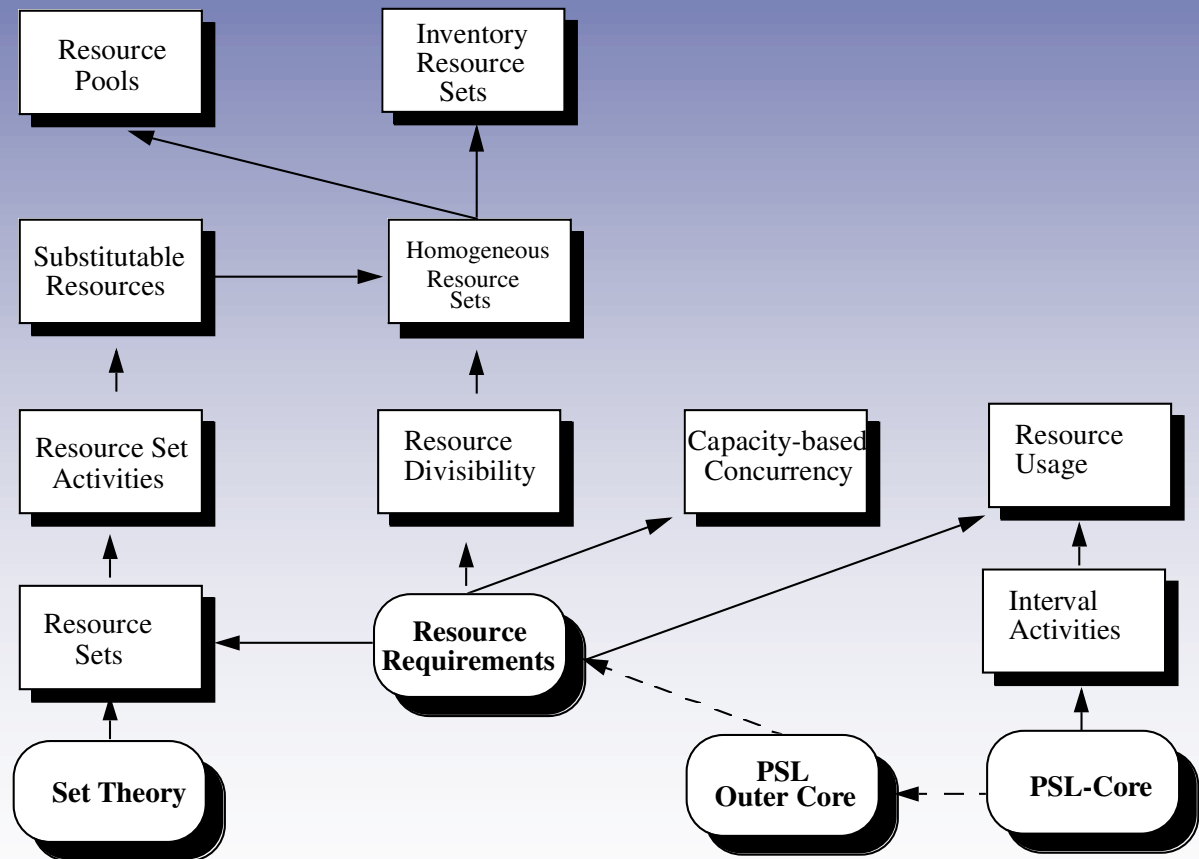# IDEF3-Related Extensions to PSL

New Extensions

- Duration
- Complex Sequences
- Durations
- Nondeterminism
- State constraints
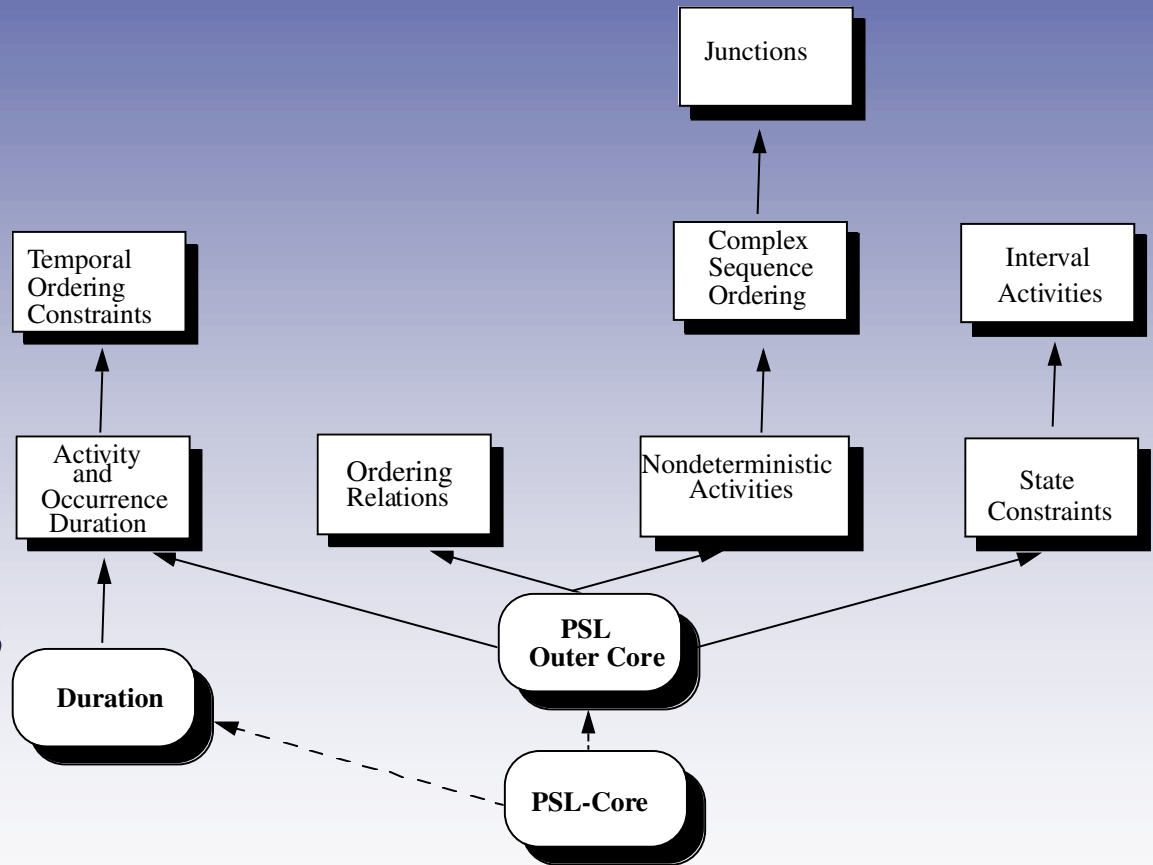
ILOG-Related Extensions in PSL

New Extensions

- Capacity-based Concurrency
- Interval Activities
- Resource Requirements
- Resource Divisibility
- Resource Sets
- Resource Pools
- Inventory Resource Sets

National Institute of Standards and Technology • Technology Administration • U.S. Department of Commerce

PSL Ontology (Example)

- All concepts in the PSL ontology are defined using KIF

- Example:

  The duration of an activity is the difference between its start and end times for all occurrences of the activity.

  (defrelation duration (?a ?d) :=
  (forall (?t1 ?t2)

  (=>   (and   (= ?t1 (Beginof ?a))
  (= ?t2 (Endof ?a)))
  (= ?d (time_minus ?t2 ?t1)))))

Translation Definitions

The *ilcActivity* concept in ILOG maps to the *activity* concept in PSL only if *activity* is both *primitive* and a *nondet_res_activity*.

```
(forall (?a)
      (=>    (and    (nondet_res_activity ?a)
                     (primitive ?a))
            (<=>   (ilcActivity ?a)
                   (activity ?a))))
```

Who is PSL's Target Audience?

- The end user of PSL would be the manufacturers who have a need to exchange process information among applications within their company (and among partnering companies).

- However, it is envisioned that PSL translators would be provided through vendors' tools.

- Therefore, the first step is to get vendors to incorporate PSL translators in their tools.

PSL Staff and Collaborations

- NIST Staff
  - Michael Gruninger (Guest Researcher)
  - Josh Lubell
  - Cyrille Brustlein (Guest Researcher)
  - Mihai Ciocoiu (Guest Researcher)
- External Collaborations
  - Intelligent Systems Technology Inc. (ISTI)
  - Knowledge Based Systems, Inc. (KBSI)
  - Penn State University
  - STEPTools Inc.

What the Future Holds for PSL

Vision for Ontology Growth

- Knowledge Based Systems Inc. - business processes

- Oak Ridge National Laboratory - agent-based simulation

- Penn State Univ.- material handling

Plans For This Fiscal Year

- Complete a second pilot implementation
- Develop a set of tutorials to help PSL users get quickly up-to-speed
- Complete the PSL/PIF integration
- Explore the use/development of tools to facilitate the use of PSL
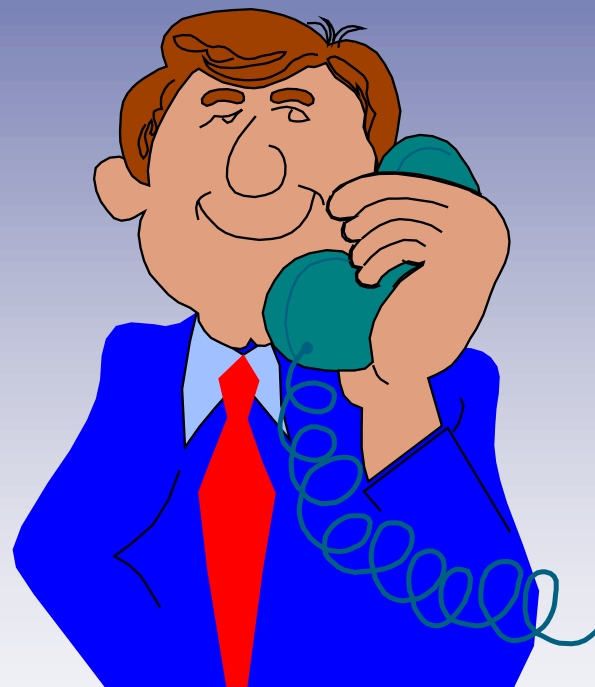- Make decision regarding the PSL syntax

Standardization

- PSL has recently been accepted as a preliminary work item within the International Organization for Standardization (ISO).

- This represents the first step in the international standardization process.

On-Going External Contacts

- Present and past most active collaborators include:

  - AgilTech, Inc.
  - Boeing Helicopters
  - Deneb Robotics
  - ESIAL University (France)
  - EPFL (Switzerland)
  - Oak Ridge National Laboratories
  - PIF (Process Interchange Format) Working Group

  - Raytheon
  - Shanghai Jiaotong Univ., P.R. China
  - University of Edinburgh, AIAI
  - University of Hawaii
  - University of Maryland, College Park
  - University of Toronto

NIST National Institute of Standards and Technology • Technology Administration • U.S. Department of Commerce

Further Questions?

Michael Gruninger
gruning@cme.nist.gov
(301) 975-6536

http://www.nist.gov/psl